ECE 345 / ME 380: Introduction to Control Systems

Course Map

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The course is split roughly into three main areas: 1) Modeling, 2) Analysis, and 3) Control. The course explores common techniques to model linear systems, to evaluate their transient response, steady-state response, and stability, and to control them to achieve stability and performance objectives.

1 Course objectives

There are specific course objectives associated with each of the three main areas (with some overlap, since the latter parts of the course build upon the earlier parts).

1. Modeling of linear dynamical systems: Construct transfer function and state-space models from differential equation models of physical systems. Relate transfer function and state-space models, and transform a system between these two frameworks. Use block-diagram manipulation to reduce a negative unity feedback system to a succinct transfer function.
2. Analysis: Characterize second-order transient response via damping ratio and natural frequency. Evaluate transient response characteristics, such as overshoot, rise time, peak time, and settling time. Characterize and evaluate steady-state response. Relate pole locations to types of stability and transient response characteristics.
3. Control: Analyze and design proportional controllers for negative unity feedback systems via root locus, Bode, and Nyquist methods. Evaluate stability via Routh tables or the Hurwitz condition. Evaluate stability via gain and phase margin, and via the Nyquist criterion.

2 Map from modules to course objectives

Each module covers a specific topic (typically, equivalent to one chapter in the textbooks). The learning objectives and activities associated with each module map to the course objectives, as described in Section 2.

Module	Content	Objectives
Module 1	Introduction	1, 3
Module 2	Transfer functions	1
Module 3	State-space models	1
Module 4	Transient response	2
Module 5	Block diagram reduction	1
Module 6	Stability	2
Module 7	Steady-state error	2
Module 8	Root locus	2, 3
Module 9	Frequency methods	3